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ABSTRACT

This study focuses on one preservice mathematics teacher in her first mathematics methods course who constituted a special section of the course. This was field-based with most of the course spent in a fourth grade classroom observing mathematics instruction, conducting task-based interviews with individual children, and teaching small groups. It was concluded that the teacher was able to change her mathematics teaching behavior to be more consistent with her beliefs about children, teaching, and learning. (ASK)

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Changing Actions vs. Changing Beliefs:

What is the goal of mathematics teacher education?

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Changing Actions vs. Changing Beliefs:
What is the goal of mathematics teacher education?

I hate math. Math was invented by someone who was very angry as a way to get back at society. And the thought of teaching math wakes me up in the middle of the night in a cold sweat. (Carrie's autobiography, April, 1994)

Teaching math is nothing more than exploring math with your students. I've learned that "wrong answers" are such a gift in the classroom because they open the doors for so much more understanding and exploration of math. (Carrie's autobiography, January, 1995)

It is difficult to imagine that both of these quotes came from the same preservice teacher only nine months apart. The research literature suggests that a person's beliefs cannot be changed in short period of time, such as the time of teacher education program. Carrie's statements above seem to suggest otherwise. To explain Carrie's seemingly miraculous transformation, I draw on Green's metaphor for belief systems (1971) and Cooney, Shealy, and Arvold's (1998) description of reflective connectionists.

Theoretical Framework

Green (1971) provided a comprehensive description of the structure of belief systems and their properties. This description has to do with how beliefs are held rather than what those beliefs are. He elaborated on three aspects of the structure of belief systems–the relationship between beliefs, the strength with which beliefs and are held, and the manner in which beliefs are clustered. A person's beliefs can be organized by their logical order into those which are

primary and those which are derived from other beliefs. Primary beliefs are so basic to a person's way of operating that she cannot give a reason for holding those beliefs; they are essentially self-evident to that person. In contrast, derivative beliefs are logically related to other beliefs.

Beliefs can also be described by the psychological strength with which they are held. Beliefs that are held with "passionate conviction" (p. 53) are called core beliefs and reside at the very center of a person's belief system. Core beliefs are not easily amenable to change and are generally fundamental to one's personality. Beliefs that are held with less psychological strength are called peripheral beliefs.

People tend to hold beliefs in isolated clusters so that the beliefs within a cluster are consistent, but beliefs are not necessarily consistent from cluster to cluster. Therefore, it is possible for a person to hold conflicting beliefs, but as long as they are held in isolated clusters and never placed side-by-side the person does not feel any conflict.

Green also distinguished between beliefs that are held on the basis of evidence and those that are held non-evidentially. Beliefs that are held on the basis of evidence are open to criticism and modification because the reasons for the beliefs can be questioned through the presentation of additional evidence. Beliefs that are held non-evidentially, however, are resistant to change because they are not based on reason or evidence.

Green contended that the purpose of teaching is to modify students' belief systems. He argued that "teaching is an activity aimed at the formation of belief systems having four principal characteristics: 1) a minimum number of core beliefs, 2) a minimum number of belief clusters with a maximum number of relations between them, 3) a maximum proportion of evidential

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beliefs, and 4) a maximum correspondence between the quasi-logical order of beliefs and the actual logical relations between them" (p. 52).

Cooney et al. (1998) posited four descriptions of preservice secondary teachers that explain how their belief systems affect their views of mathematics teaching and how amenable these beliefs systems are to change. They characterized preservice teachers as naïve idealists, isolationists, naïve connectionists, and reflective connectionists. Their description of a reflective connectionist comes closes to matching Green's description of a person with an ideal belief system. Cooney et al. (1998) described a reflective connectionist as one who "integrates voices, analyzes the merits of various positions, and comes to terms with what he or she believes in a committed way. It sets the stage for becoming a reflective practitioner" (p. 330).

Methods

Data collection. During the fall of 1994 I conducted a study of four preservice elementary teachers who were enrolled in their first mathematics methods course. Carrie, who is the focus of this paper, was one of the four preservice teachers in this course. The four preservice teachers constituted a special section of the course for which I was the instructor. The course was field-based with most of the course spent in a fourth grade classroom observing mathematics instruction, conducting task-based interviews with individual children, and teaching small groups. There was also extensive time for dialogue between the preservice teachers, the classroom teacher, and me. Data collected during this study included two individual interviews, Carrie's journal, 4 audiotapes of Carrie conducting task-based interviews with individual children, 3 audio tapes of Carrie teaching a small group, 1 videotape of her teaching a small group, field notes on 8 observations of the classroom teacher, and audiotapes and field notes

from 8 discussions among the four preservice teachers, the cooperating teacher, and me. See Mewborn (1999) for more details of the study.

I kept anecdotal records of informal conversations with Carrie during the first two years of her teaching career. During the third year (the 1997-98 school year), I conducted a study of Carrie's teaching. Data from this study include field notes from weekly classroom observations, 2 individual interviews, and classroom artifacts such as lesson plans, classroom displays, and student work. Half of the data collection during this study was done by a graduate research assistant, and half of it was done by me.

Data Analysis. The data were analyzed from the perspective of the interpretive paradigm for teacher socialization (Zeichner & Gore, 1990). The interpretive approach involves an attempt to understand the nature of a social setting at the level of subjective experience. The purpose of the approach is to gain an understanding of the situation from the perspective of the participants and within their levels of consciousness and subjectivity.

The data were analyzed using the methods of grounded theory (Glaser & Strauss, 1967) and grounded interpretivism (Addison, 1989). The grounded theory method is a systematic inductive procedure for gathering and analyzing data for the purpose of generating a theory (Glaser & Strauss, 1967). Grounded theory and interpretive research methods are both constant comparative methods in which the researcher is constantly looking for and questioning "gaps, omissions, inconsistencies, misunderstandings, and not-yet understandings" (Addison, 1989, p. 41). Both methods also emphasize the importance of context and social structure in research settings, and in both methods data collection, coding, and analysis continue throughout the research process.

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I analyzed the transcriptions of the raw data using HyperRESEARCH (Hesse-Biber, 1993), a computerized qualitative data analysis tool. The software facilitates chunking data and assigning codes or descriptors to each chunk. The data can easily be rechunked, and a particular chunk can be assigned multiple codes. The software also allows the data to be sorted according to the codes it has been assigned.

Carrie's Background

Carrie was a Caucasian female, and at the time of the initial study she was a 21 year old college senior. Carrie initially majored in child psychology because she wanted to work with children but did not want to fulfill the stereotype of women in elementary education. After realizing that she would have problems with taking her work home with her if she worked with troubled children, she decided to change her major to elementary education. She chose elementary education because she thought that elementary children are at a crucial age where they need to be loved and cared for, and she wanted to provide that love and caring. Carrie demonstrated a strong care ethic. She stated that she wanted her classroom to be a safe and loving environment for children. Prior to entering her teacher education program, Carrie had worked with preschool children through a daycare job, all ages of children through coaching swim team, and high school students through a religious organization.

Upon graduation from college with a degree in early childhood education, Carried decided to apply to graduate school in the field of gifted education. She said that she wanted to study gifted education not because she had any special interest in working with gifted students but because she thought that the types of activities and teaching that were used with gifted students should be applicable to all students. After spending part of the summer after graduation

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in Europe with a friend, Carrie came to me before the beginning of fall term to say that she thought she had made a mistake by not seeking a teaching job. She said she wanted to be in a classroom teaching and was not looking forward to graduate school. One of Carrie's peers, Hanna, had been hired in the school where they both did their student teaching. Hanna learned of an opening for a teacher's aide in the school and encouraged Carrie to apply for the position. Carrie was hired as a teacher's aide in a first grade classroom and obtained a job as a second grade teacher the following year. She taught second grade at the school for two years before moving to a new community after getting married. It was during her second year of teaching that the follow-up study occurred.

Carrie's Beliefs and Their Manifestation in Classroom Practice

Carrie's core belief stemmed from her concerns about the societal and family situations that impact negatively on children's lives. She believed that teachers should treat children with love, compassion, and respect. She believed that school should be a place where children interact with adults who love and care about them as human beings, and she saw school as a place that could rectify the unpleasantness in some children's lives. She held beliefs about students, learning, and teaching that were derived from her primary belief about respecting children, and these beliefs were clearly manifested in her mathematics teaching.

Carrie believed that children must have confidence in themselves as learners if they are to be successful in school and in life. In her interactions with children, Carrie placed a lot of emphasis on children's mathematical thinking, and she took every opportunity to praise and reward children for their thinking. Carrie thought it was important to find something of value in each child's thinking, regardless of the correctness of the response.

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Carrie believed that learning mathematics is a process of understanding, not a means to a correct answer. Carrie manifested this belief in her teaching practice by insisting that children explain their answers and by seeking and rewarding multiple solution processes.

Carrie believed that teachers should be role models for their students. In order for her students to be willing to engage in the types of discussions she desired, Carried thought it was important for her to model her mathematical thinking for them. She also believed that it was important to "be human" and admit to making errors or admit to not knowing the answer in front of her students.

Carrie's beliefs about students, learning, and teaching were tightly clustered in a coherent set. However, as a preservice teacher Carrie held a cluster of beliefs about mathematics as a discipline, about herself as a learner of mathematics, and about herself as a teacher of mathematics that was in sharp contradiction to her general teaching and learning belief cluster.

Carrie did not look forward to teaching mathematics to children, mainly because she did not think she could do a good job of it. Carrie's belief that a teacher is a role model was a source of significant conflict for her because she knew that she was not able to model excitement and enthusiasm for learning mathematics. As a result of a field experience in which she worked with a skilled mathematics teacher, Carrie saw that it was possible for students to experience mathematics as a dynamic, creative, fun, interesting discipline with opportunities for individual exploration and interpretation. She was then able to find ways to shape her teaching practice that were consistent with her other beliefs. For Carrie, the problem of teaching mathematics was resolved. She had brought her conflicting belief clusters into line and had resolved the conflict.

Conclusions

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The data seem to support Guskey's (1986) claim that change in belief follows, rather than precedes, change in behavior. Carrie was able to change her mathematics teaching behavior to be more consistent with her beliefs about children, teaching, and learning. This change in behavior was accompanied by a change in her beliefs about school mathematics over the course of 3 years. However, there is no evidence to suggest that Carrie substantially altered her beliefs about mathematics as a discipline or about herself as a learner of mathematics. It is plausible that because she saw herself as capable of successfully teaching mathematics, she gave herself license to lock away her beliefs about mathematics. She was no longer troubled by the stark contrast between her beliefs about mathematics and her beliefs about other content areas because she was able to teach the content of school mathematics in a way that was consistent with her core and derivative beliefs about teaching, learning, and children. Thus, she was able to accept that she held an isolated and conflicting cluster of beliefs about mathematics, and she no longer had to bring that cluster of beliefs into contrast with her other beliefs.

The structure of Carrie's belief system enabled her to change her actions and beliefs because all of her beliefs, except those about mathematics as a discipline, were logically related, and they were held evidentially. Once she brought her beliefs about school mathematics into the cluster with her beliefs about students, learning, and teaching, she was no longer troubled by the conflict between her belief clusters. The process by which Carrie altered her actions and beliefs is consistent with the description given by Cooney et al. (1998) of a reflective connectionist. Carrie integrated her experiences as a learner with her experiences in her teacher education program, analyzed the merits of various positions and changed her teaching practice to be consistent with her beliefs. She was able to come to terms with her beliefs in a committed way because she was able to hold conflicting beliefs in isolated clusters.

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